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AUTHOR Garrigan, Scott

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ABSTRACT

BEN:LINCS (Bethlehem Education Network: A Local Instructional Network for Culture and Science), a Pennsylvania Testbed Project, attempts to demonstrate a sustainable model that supports network-based educational activities among schools, homes, libraries, museums, and local cultural organizations. The BEN:LINCS project envisioned a community-based network of local organizations making their educational resources available over the World Wide Web. Highly motivating learning activities would be developed that were relevant to the community and that could engage students in school or at home. This paper begins with an overview of BEN:LINCS and its partners. Ten projects are then described in the following categories: (1) SMART Net, projects that involve the SMART Discovery Center (a local science museum) and Lehigh University's Electron Microscopy Laboratory; (2) Local Library Web, a Web-based means to contact and search local library catalogs; and (3) Close-to-Home Curriculum, network-enabled activities using local history, music, and science resources and organizations. Implementation issues of leadership, vision, staffing, technology, curriculum/education, and change are also discussed. The BEN:LINCS model suggests that extensive technological resources may not be necessary to begin a community education network; the only critical need is for basic Internet connectivity. The model also suggests that it may not be necessary to hire expensive full-time staff. (AEF)

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Research Paper: Technology Implementation

# BEN:LINCS: A Community Model for the Pennsylvania Education Network

Scott Garrigan
Bethlehem Area School District
Network Center
3149 Chester Avenue
Bethlehem, PA 18020
610.807.5571
sgarrigan@beth.k12.pa.us

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## Abstract

BEN:LINCS, a Pennsylvania Testbed Project, attempts to demonstrate a sustainable model that supports network-based educational activities among schools, homes, libraries, museums, and local cultural organizations.

## Project Educational Goal

In 1997, the Commonwealth of Pennsylvania elected to fund 14 out of over 200 proposals to develop models for the future Pennsylvania Education Network. The BEN:LINCS Project was funded as a Technology Testbed Link-to-Learn Project to develop (over a two-year period, 1997–99) a community-based educational network model which might be transferable to other communities. Link-to-Learn is the name of Pennsylvania's educational technology initiative. Key criteria were that the network should be economically and technologically sustainable after the close of the project funding. BEN:LINCS stands for the Bethlehem Education Network: A Local Instructional Network for Culture and Science.

The building of community-based networks has been closely monitored ever since the Blacksburg Electronic Village (www.bev.net) prototype. BEV began out of 1992 discussions among Virginia Polytech, Blacksburg and Bell Atlantic, and its growth has coincided with the growth of the World Wide Web. The Initial model of BEV was to provide high-quality network access throughout their Appalachian community. To do that it created a centralized model—a central office and organization—to provide connectivity and to maintain the community network. That office was projected to cost about $200,000 per year, of which 90% was staff cost. The BEV model has been successful, in part, due to support from major organizations such as Bell Atlantic and VPI, significant grant funding, and a central office and staff.

In spite of the BEV's strong model, it appears that most community networks have not been able to enlist similar financial and organizational support. A national organization founded to support community networks, the National Public

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Telecomputing Network (NPTN), filed for bankruptcy in 1997. It emphasized the "Free-Net" model that evolved in Cleveland in the electronic bulletin board days before the Internet. Free-Nets emphasize "free" connectivity to the community network. I would suggest that the popularity of the Internet and the increasing availability of low-cost, high-quality Internet service has undermined the basis of most Free-Nets as it has undermined NPTN. Some recent community-based networks have been "school-centered," focusing on achieving school objectives through associations with other schools and with the community (e.g., Becker and Hunter, 1998). Others have focused on building the required Internet infrastructure (Gusky, 1997) or on networking disadvantaged communities (Wells, Bowlin, Callaway, Champagne, & Quebodeaux, 1998). Some, like KC-Net and FoxNet (Gusky, 1997), have focused on networking the larger social players such as hospitals, local government, social agencies, and libraries to local schools and universities. BEN:LINCS had a different focus—to put some of our local cultural, historic, scientific and educational resources on the Web for the benefit of our students and our community.

The BEN:LINCS project envisioned a community-based network of local educational resource providers. In the same way that the Internet provides access to international resources, BEN:LINCS would help local organizations make their educational resources available over the World Wide Web. BEN:LINCS would be composed of a group of partners, each a provider of information resources rather than a consumer of resources—partners such as local libraries, museums, and historical societies. Highly motivating learning activities would be developed that were relevant to the community and that could engage students in school or at home. This network could strengthen the bonds among schools, families, and the community.

The BEN:LINCS Project was designed to use seed money to help each partner develop a Web presence of educational resources and activities. Standard Internet technologies and protocols were selected in order to base the network on inexpensive, easy-to-support technologies. Each organization's core mission and current staff were to be leveraged to provide the educational services they wished to provide, but through a new medium, the Internet. This design required neither long-term organization nor new permanent staff, and each organization would have the continuing motivation to maintain their educational site as an economical way to reach their target audience.

## The Project and Its Partners

BEN:LINCS was a partnership among Lehigh University, the SMART Discovery Center (a local science museum), the Bethlehem Area School District, the Bethlehem Area Public Library, Historic Bethlehem Inc., the Moravian Museum (a local historical museum), the Bach Choir, and the Moravian College Music Department. After it was funded, the Project gained the support of Winnebago Software Company and Apple Computer as corporate partners. The project co-directors were from the Bethlehem Area School District and from Lehigh University. The school district co-director was to handle educational and operational tasks, and the university co-director was to handle finances and institutional liaison. The award was granted to Lehigh University as the fiscal agent.

The BEN:LINCS Project sought to provide information-rich links to exemplary curriculum-focused regional resources. Building on existing networks such as the Internet, the Lehigh University Network, and Bethlehem Education Network (BEN is the school district network), the BEN:LINCS partnership proposed a series of 10 projects that would create network-enabled activities designed to motivate and empower students and their teachers. The projects would use current Internet standards and the unique expertise of the Project Team to leverage existing world class local resources in science, history, and the arts to world class learning resources that can serve as a model for larger educational networks, such as the Pennsylvania Education Network.

The 10 projects were arranged into three logical groups as described below: SMART Net, Local Library Web, and Close-To-Home Curriculum. Individually, some of the projects, such as SMART Telemicroscopy or SoftSEM, offered remarkable educational opportunities within their discipline. Together, however, the BEN:LINCS projects permit us to glimpse a future network that provides powerful learning opportunities on any topic from any place at any time to any person of any age. This future network would enable students to actively explore knowledge at their own pace; to collaborate with experts, mentors, peers, teachers, and mentees; and to create projects that not only cross traditional subject boundaries, but combine relevant kinds of media that appeal to individual and multiple learning modalities. It is this vision that drove and directed BEN:LINCS, and it is this vision that should drive the Pennsylvania Education Network.

A. SMART Net is a group of five projects that involve the SMART Discovery Center (SDC—now named the Discovery Center) and Lehigh University's Electron Microscopy Laboratory.

   1. SMART Telemicroscopy will allow students to explore over the Internet a three-dimensional microworld with a scanning electron microscope in much the same way that they now navigate through underwater wonders with Dr. Robert Ballard of the JASON Project.

   2. SoftSEM will simulate over the Internet the operation of a scanning electron microscope. Students will use SoftSEM to explore exemplary previously photographed specimens and to learn how to operate the SMART Telemicroscope.

   3. SMART Link will be a fiberoptic cable that will connect SDC to Lehigh University to support very high bandwidth activities between the two sites, including dramatic telepresence activities such as the JASON Project in the SDC's JASON Theater.

   4. JASON Outreach will be an educational Web site devoted to involving students with the JASON Project on a long-term, in-depth basis.

   5. Hands-On-Science Web will be an educational Web site devoted to furthering the SDC's principles discovery learning through manipulation of a microworld of concrete science materials. A series of engaging home and school activities will be created that introduce, explore, and expand the hands-on exhibits at the SDC.

B. Local Library Web will provide a Web-based means to contact and search all local library catalogs over the Internet. Patrons can search several library catalogs with a single interface and a single search.

6. The Bethlehem Area Public Library will connect its automated library system to the Internet through a security firewall to provide Web-based catalog access and open-standard searching of multiple library catalogs (z-39.50).

7. The Bethlehem Area School District Libraries will update 3 school libraries and automate 12 more to provide a total of 16 school libraries with the capability of searching their catalog over the Internet from student homes or from any classroom, and the capability of open-standard searching of multiple library catalogs.

C. Close-to-Home Curriculum will provide highly motivating, network-enabled activities using local history, music, science resources, and organizations.

8. The Interactive History of Local Technology and Industry project will begin the process of making a wealth of regional history available in engaging Internet-enabled learning modules. The Lehigh Valley and the City of Bethlehem occupy unique positions in the history of American technology and industry. For example, Lehigh County was once the leading producer of iron ore, slate, cement and potatoes, and Bethlehem had an Early American Industrial Park before the Revolutionary War! The project will begin with learning modules of sites that are important to that history.

9. Bethlehem's Living Musical Heritage will begin a similar process to capture on the Internet the 250 years of rich musical history in the City of Bethlehem, including distinctions such as the oldest continuously performing musical organization in America and the first violin and viola made in the United States.

10. Planetarium Online will be an online high school course designed for students to learn astronomy in the same way that scientists study astronomy: collaboratively over the Internet in a project-based environment.

## Implementation Issues

Implementation of BEN:LINCS has been underway for almost two years, and in that time issues have surfaced that may be generic to any similar project. During that time we have seen that some of our original approaches appear to work and that some had to be modified. This is information that could be valuable to any community-related education project.

1. LEADERSHIP. A few key people determine the success of this kind of project. The Project Leaders must be dedicated to the task. The support of the leaders' parent organization is essential, and secretarial help is valuable. Neither the BEN:LINCS leaders nor their organizations were paid for their

time. It was the dedication of the leaders to educational and community ideals that would make it work, or not. While any permanent project staff may appear to be a strength and may help the project start, that staff can become a liability when the funding stops. Sometimes a permanent staff winds up dedicated to a perpetual search for outside funding. It was the BEN:LINCS vision that the long-term success of the project should not depend upon continued funding beyond the start up period.

2. VISION. It is the leaders' job to build a shared vision among the partners to identify their common community and educational goals. Organizations and individuals will work hard to further their own goals, but not to further those of someone else. Communication and trust are desperately needed to help organizations work together who are not used to working together. It is common for small organizations to be highly independent and parochial until they realize how the larger project will help them. For example, BEN:LINCS found that most community organizations genuinely want to help students and many have explicit educational missions. But the organizations will not work wholeheartedly on the project until they realize that the site also has promotional value for them.

3. STAFFING. BEN:LINCS tried to use only existing staff, volunteers, and a very few paid teachers and/or webmasters to carry out the project. All of the larger organizations were able to carry out the project with no additional staff. The smaller community organizations, however, needed help. It quickly became clear that two distinct kinds of skills were needed: (1) domain knowledge about the organization and its treasures, and (2) technical knowledge about computers, networks, and Internet. It turned out to be impossible to find anyone with the requisite domain knowledge (e.g., knowledge of photos of Historic Bethlehem) other than the current busy staffs of the small organizations. These people needed to be compensated for their time. This will remain a dominant issue as the project continues.

Technical staffing was covered by volunteers, community service high school students, and graduate students. It is possible that start up, paid, technical staffing would have been helpful, but the project could be put at risk if such a key person leaves or when the money runs out. It seems that the problem of adequate technical staffing is easier to resolve than the problem of adequate domain-knowledge staff. Many people in the community have the requisite technical skills, but the domain-knowledge is very, very scarce. One problem to be expected of the technical stall is that of maintaining a high level of quality and aesthetic attributes of the Web sites.

As the project develops, talented individuals may be attracted to the project. For example, a retiring music professor discovered that the BEN:LINCS music goal was one that he had been striving toward for his entire professional career. He decided to devote himself to that goal in his retirement. Community and educational goals strike deep chords in some people who may be willing to commit tremendous energy and competence to this kind of project.

4. TECHNOLOGY. A conscious decision was made to use inexpensive, easily available, empowering technologies that support Internet protocols over the

World Wide Web. All of the projects except telemicroscopy use asynchronous protocols (like Web and e-mail) so the activities are available anywhere, any time. A decision was made to favor technologies that do not require an attendant operator or specially skilled additional staff. The Telemicroscopy project is an exception to this decision because a microscopy assistant must be present at the remote site. This implies that a synchronous protocol such as teleconferencing must be used to communicate between the user and the operator.

The basic technology for developing educational activities was the Web site. Interactivity was provided by JavaScript and QuickTime VR, both freely available for any kind of computer. Collaboration is provided through standard Internet e-mail and forms technologies. The project chose other well-established technologies such as ethernet LANs over copper, fiberoptic WANs, and w[illegible] supported library automation and Web-publishing solutions. In general, these technologies have proven powerful enough to revolutionize higher education and business on a worldwide scale, and they would appear to be powerful enough to build the Pennsylvania Education Network at a minimal initial cost and with minimal ongoing maintenance and staffing costs.

BEN:LINCS assumed that the Internet infrastructure is or will shortly be in place, and it assumed that the building of that infrastructure is the province of utility companies from whom economical service may be purchased. Thus the hardware and network budget could be quite minimal if we assumed the existence of good transport media. It seemed wise for the project to focus on the creation of information and educational activities rather than on maintaining a telecommunications infrastructure. This assumption is probably a good one in urban areas and a poor assumption in rural areas.

Server space was shared by the participants. Since a new Web site does not need a large amount of storage, and since the small organizations do not have server administration expertise, it made sense to share existing Web servers rather than to purchase, set up, train personnel, and maintain new ones. The school district made space available on their Web servers for the historical and musical organizations. Apple Computer donated a Web server to the Discovery Center because they had a resident Webmaster (a position that was subsequently eliminated due to budget cuts!)

5. CURRICULUM/EDUCATION. In the first two years of BEN:LINCS, a collaborative infrastructure was built which can be put to educational use. Pilot educational activities and resources are nearing completion. The next phase of the project is the sharing of these models with the partners and the development of the model activities by a wider group of people. Building a Web-friendly Internet presence for each organization is a long job, and any educational payoff cannot come until the infrastructure is ready. Any similar project should be aware that the start up times may be much longer than originally anticipated (as BEN:LINCS discovered!)

6. CHANGE. The project suffered critical personnel changes (a co-director moved out of the area), organizational changes, and technology changes. It

is necessary to expect changes and to expect to accommodate them. For example, the SMART Discovery Center was totally reorganized with a change of name, mission, board, administration, location, and most staff! The software to put library catalogs on the Web was a problem due to the rapid change of technology. The Dynix library system of the public library underwent two significant releases to provide this capability. The public library is now on the Web, but not all features are working in the current software release, and they have not yet begun to implement the z39.50 protocol to make their catalog compatible with those of other catalog search engines. The school libraries benefited from the generosity of the Winnebago Software Company, whose software was selected to automate all school libraries. The Web component of the Winnebago Spectrum system was announced three years ago but has yet to be shipped. We found that this delay is not unusual for new software capabilities.

We expect that eight out of our original ten projects will be successful and that they will continue to grow under the auspices of their parent organizations. Any similar project needs to expect changes and needs to be flexible enough to accommodate them. Accurate time projections are impossible, and to expect close adhesion to a timetable is probably counterproductive.

## The Future of BEN:LINCS

It seems clear that each of the BEN:LINCS partners will continue to develop their Internet presence. It also seems clear that each partner will develop that presence according to its own priorities, and that this development will provide additional information and services to the community. The big question that remains is the development of high quality educational resources by each partner. It is difficult to produce high quality educational activities. It was difficult to find individuals with the appropriate blend of skills to build pilot activities. I suspect that the school district may have to continue to provide leadership in this area. BEN:LINCS will continue to try to develop the model community-based and network-based educational activities that it originally proposed.

## Summary

BEN:LINCS was designed to be a replicable model that any community can follow. It provides a powerful vision of how all of the education stakeholders in a region can collaborate to share resources or provide educational experiences to children at school and at home. BEN:LINCS resource providers included the school libraries, the public library, the university, and several local museums and cultural organizations. The BEN:LINCS model can be replicated using the unique resources that every region has. Every region has its libraries, its historical and cultural organizations, and its schools, which can collaborate to strengthen the educational experience of each child as well as strengthen the fabric of the community.

Two significant questions remain that BEN:LINCS was designed to have answered but has not: (1) Can such a project run successfully without a central organization and staff? and, (2) Can community organizations, in collaboration with school districts, develop high quality, Internet-enabled educational activities? The two-year

BEN:LINCS grant was enough time to build the infrastructure and the working relationships, but not enough time to build the educational activities.

Although community resources and money may be scarce, the BEN:LINCS model suggests that extensive technological resources may not be necessary to begin a community education network; the only critical need is for basic Internet connectivity. The BEN:LINCS model also suggests that it may not be necessary to hire expensive full-time staff. The BEN:LINCS vision is to integrate technology into the EXISTING fabric of the community rather than to add an expensive layer of technology bureaucracy on top of the community. It remains to be seen whether the BEN:LINCS model will be a successful model for other communities to follow.

Presentation and handout material are available at http://www2.beth.k12.pa.us/projects/ben_lincs/pres.html.

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